PATENT SPECIFICATION (11) 1 303 730

1 303 730

DRAWINGS ATTACHED

(21) Application No. 24892/70 (22) Filed 22 May 1970

(44) Complete Specification published 17 Jan. 1973

(51) International Classification G01P 5/08

(52) Index at acceptance G1N 273

(72) Inventor JOHANNES GREGORIUS AUGUSTINUS and VAN BREUGEL

(19)

(54) AN APPARATUS FOR MEASURING ALTERNATING VOLTAGES IN AN ELECTROLYTE

(71) We, DATAWELL N.V., a Dutch Body Corporate, of Zomerluststraat 4, Haarlem, Netherlands, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an apparatus for measuring alternating voltages in a free electrolyte.

When measuring voltages in a moving electrolyte, considerable disturbances occur. For example, when measuring the flow velocity of a fluid by means of measuring the voltage which is generated between electrodes in a magnetic field, disturbances occur which limit the accuracy of the measurement.

In the past, the use of electrodes of stainless steel has been suggested for measuring voltage in seawater. These known electrodes have the advantage of being extremely resistant to corrosion, but on the other hand they have considerable disadvantages with respect to disturbances in the measurement, because juxta-positioned crystals within the electrode material have somewhat different compositions and because the interface potentials of the crystals are dependent on the crystal orientation. Moreover acorn-shell like impurities and the like can grow on the surface of the electrode, which can induce very important disturbances.

For measuring the flow velocity of an electrically conducting liquid in pipe lines, silver electrodes have already been suggested. The disturbances in the measurement mainly arise because of inhomogeneities of the electrode lead to different interface potentials which results in different current densities. These different current densities generate an electrical noise voltage in combination with the movement of the electrolyte. A further serious difficulty is that the electrode gradually has some form of scale form on its surface, e.g. arcon-shell like impurity formations, which interfere with the electrical contact between the free electrolyte and the electrode.

The present invention aims at providing an electrode, which e.g. can be used for long periods of time, for example, for one year in seawater, and which is not subject to fluctuating disturbances, and which, moreover, increases the accuracy of the measurement considerably, by almost completely eliminating the disturbances in voltage measurements.

According to the present invention there is provided an apparatus for measuring alternating voltages in a free electrolyte, comprising an enclosed portion bounded at least in part by a pervious wall to provide for the entrance of the electrolyte, and an elongated copper containing conductor wire surrounded by a pervious insulation material disposed within the enclosure, said elongated wire being folded to and fro within said enclosure so as to limit the size of the intersticies between adjacent portions of said wire and to thereby severely impede circulation of the electrolyte within the enclosure.

In use, a mass of electrolyte enters the enclosed portion through the pervious wall to form a bounded electrolyte mass containing copper ions which is separated from the free electrolyte by means of the pervious wall, As a result, the flow of free electrolyte passing along the pervious wall is hardly disturbed. The flow of electrolyte through the pervious wall is limited. The pervious wall can at the same time serve to mechanically hold the wire within the enclosure.

The conductor contains copper since copper ions in the bounded electrolyte mass are thus obtained. A further advantage is that copper has a very constant interfacial potential.

According to a further improvement of the invention, a viscosity increasing substance can be added to the enclosure to increase the viscosity of the bounded electrolyte mass, by which the liquid exchange between the bounded

electrolyte mass and the free electrolyte is still further limited.

The invention will now further be elucidated with reference to the accompanying drawing, in which the single Figure is a sectional view of an electrode of the present invention.

In the single figure, a recess 2 is shown in a solid body 1. In the recess, a very thin copper wire 3, which has been provided with a pervious insulation cover 4, e.g. a thin cotton fabric or a pervious insulating envelope, has been randomly folded to and fro in the recess 2. An inner conductor 5 of the wire 3 forms the lead-in of the electrode. The recess 2 is de-limited on one side by means of a perforated plate 6 of an electrochemically inactive material. Because the wire 3 has been folded to and fro many times in a regular or irregular configuration. the movement of electrically conducting liquid in the recess 2 is hampered to a very considerable extent. First of all, strong resistance to movement of liquid is provided by the insulation cover 4 and secondly the randomly folded wire 3 hampers movement of the liquid in the interspace between adjacent portions of the wire. Owing to this, the liquid in the recess 2 forms a relatively immobilized electrolyte body.

When the apparatus illustrated is placed in an electric field, the voltage of which is to be measured by means of a measuring apparatus (not shown) connected to the inner conductor 5 of the wire 3, it is possible that different voltages will be present at adjacent points for example points 8 and 9. This may be caused for example by small inhomogeneities of the conductor 5 within the wire 3 present in the recess 2. Thus, different current densities will occur in the points 8 and 9. As however, the electrolyte mass at these points has hardly any flow movement, these differences in current density can hardly give rise to noise voltages. Moreover, existing electrical noise voltages, if any, will get smaller and smaller near the plate 6 and they will amount to nearly zero at perforations 7 in the plate 6.

Because the copper of the conductor 5 gradually dissolves in the electrolyte inside the recess 2, a relatively high copper ion concentration will prevail in that recess, said concentration decreasing somewhat in the direction of the perforated plate 6. This high copper ion concentration is such that arcon-shell impurity formations cannot grow. Growth of acorn-shell formations, if any, at the outside of the plate 6, it is true, is counteracted to a considerable less degree, but acorn-shells formed at that place do not influence the operation of the apparatus, as long as they do not lead to the perforations 7 becoming overgrown.

With the present invention it is possible to obtain measurements limited in accuracy only by noise of the order of magnitude of Nyquist-noise. Using the electrode of the invention, the sensitivity of electrodynamical flow velocity meters can be increased to a very considerable degree.

It is pointed out that in the illustrated embodiment a structure is formed by the wire 3 which has been folded to and fro and which contains may fine free passages between the conductor and the free electrolyte.

A substance increasing the viscosity, said substance being known in itself, can be added to the electrolyte in the recess 2. This to a further degree hampers the movement of the liquid in this recess.

The perforated plate 6 has the task of retaining wire 3 within the recess and to define one wall of the recess 2, the perforations 7 allowing electrical contact between the electrolyte in the recess 2 and the free electrolyte E.

It is pointed to the fact that the flow limiting means, in this case the wire and its insulation, do not have a depolarizing function, because alternating voltages are measured. This can take place in a known way with flow velocity measurements by exciting the voltages to be measured with an alternating magnetic field.

Because the very long inner conductor 5 of the wire 3 has a large surface in the recess 2, the interface resistance between this conductor and the electrolyte body present in the recess 2 is also small which keeps the noise potential caused by said interface resistance low.

For increasing the contact surface of the wire, it preferably comprises a number of thin parallel sub-wires (Litze).

WHAT WE CLAIM IS:—

1. An apparatus for measuring alternating voltages in a free electrolyte, comprising an enclosed portion bounded at least in part by a pervious wall to provide for the entrance of the electrolyte, and an elongated copper containing conductor wire surrounded by a pervious insulation material disposed within the enclosure, said elongated wire being folded to and fro within said enclosure so as to limit the size of the intersticies between adjacent portions of said wire and to thereby severely impede circulation of the electrolyte within the enclosure.

2. An apparatus according to claim 1, wherein the elongated copper containing wire comprises a number of subwires.

3. An apparatus according to claim 1 or 2, wherein the elongated conductor consists of copper alone.

4. An apparatus according to one or more of the preceding claims, wherein viscosity increasing means have been added to the enclosure.

5. An apparatus for measuring alternating voltages in a free electrolyte substantially as herein described withrefe rence to the accompanying drawing.

ELKINGTON AND FIFE
Chartered Patent Agents,
High Holborn House,
52/54 High Holborn,
London, W.C.1.
Agents for the Applicants

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1973.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1303730 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*